canso
civil air navigation services organisation

Best Practice Guide to Crossing Flight Information Region Boundaries

www.canso.org

Best Practice Guide to Crossing Flight Information Region Boundaries

Introduction

CANSO's vision is to transform air traffic management (ATM) performance globally; and a key objective is to harmonise airspace so that planes can fly smoothly and seamlessly across the globe. The objective of this best practice guide is to assist air navigation service providers (ANSPs) to deliver seamless service across Flight Information Region (FIR) boundaries; optimising the seamless and efficient flow of long-haul international air traffic across all regions.

In its Guide to Seamless Airspace (2013), CANSO defined seamless airspace as "contiguous airspace that is technically and procedurally interoperable, universally safe, and in which all categories of airspace users transition between Flight Information Regions, or other vertical or horizontal boundaries, without requiring a considered action to facilitate that transition and without any noticeable change in the type or quality of service received; air navigation communications performance standards; or standard practices to be followed."

CANSO has identified that efficiency in crossing FIR boundaries is currently impacted by disparities in: separation standards; procedures in filing flight-plans; air traffic flow management (ATFM) measures; pilot-to-controller and controller-to-controller communication capabilities; incompatibilities between adjacent automation platforms; and inconsistent airspace structures.

This guide focuses on establishing best practices that will help mitigate two of the impediments to the smooth crossing of FIR boundaries initially identified by CANSO Members (see Annex A): the quality of flight plans and the transition of aircraft between surveillance and non-surveillance airspace.

Quality of flight plans was chosen because of the residual effect that erroneous, missing, duplicate, and multiple flight plans have on the service provided by ANSPs. These inaccuracies affect every phase of a flight as it transitions from the tower, terminal, en-route, and oceanic environments. Service providers are not able to deliver safe, orderly, and expeditious services to operators if the service is based on erroneous flight plan data. Service providers and operators are also negatively impacted when more than one flight plan exists that contains varying elements.

The second area addresses the inefficiencies and errors that often occur when an aircraft transitions from surveillance to non-surveillance airspace, particularly due to the change in required separation standard.

The guidance will help ANSPs facilitate the reduction or elimination of factors that contribute to operational inefficiencies, unnecessary fuel burn, CO_2 emissions, and loss of required separation standards as aircraft cross FIR boundaries.

This publication is intended to complement guidance material that is already provided by CANSO's industry partners - the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA), and Airports Council International (ACI).

Best Practice Guide to Crossing Flight Information Region (FIR) Boundaries is a publication of CANSO and was developed by its FIR Boundary Crossing Task Force (FIRBX TF). The document was created based on a review of current experiences and practices of CANSO Members, and the associated standards and procedures for air navigation services established in ICAO documents and annexes.

Acknowledgements

This publication was produced by the Flight Information Region Boundary Crossing Task Force of CANSO's Operations Standing Committee. CANSO would like to thank Jorge Chades, FAA; Greg Dansereau, NAV CANADA; Ajay Joshi, AAI; Craig Roberts, Thales; Michael Snell, Dirk Hunter and Rick Taylor, Airservices Australia. The authors wish to acknowledge the valuable input provided by Marco Vidal, IATA, IDAC and many other contributing CANSO Members.

Executive Summary

CANSO Member ANSPs identified discrepancies in technical, equipment, operational, and procedural areas as hindering the safe, efficient, and seamless transition of air traffic across FIR boundaries. These identified discrepancies, which can be found in Annex A, were prioritised as high, medium, or low in terms of impact to safety and efficiency. This CANSO *Best Practice Guide to Flight Information Region (FIR) Boundaries* recommends mitigation strategies and best practices for two of the high priority discrepancies: filing flight plans and associated movement messages; and the transition of aircraft between surveillance and non-surveillance airspace. This guidance will assist in providing a procedurally interoperable ATM system that promotes a seamless airspace environment.

The recommendations regarding flight-planning are based on the review and analysis by the FIRBX TF of errors commonly found in filing, transmitting, processing, and transferring flight plans and associated messages across FIR boundaries.

The introduction of duplicate or multiple flight plans, or flight plans containing erroneous information, has a direct impact on safety and efficiency. Flight-planning processes are still performed manually by some ANSPs in various parts of the world. These manual processes, such as handwritten information on flight progress strips, landline voice coordination, and manual computer inputs, introduce the potential of human error that may have implications to the safety and operation of the flight as it transitions from departure aerodrome to destination aerodrome.

Flight plan content, including understanding which fields are mandatory and which are not; transmission and processing of flight plans, including the appropriate delegation of authority and duty; and communication and coordination are key areas that ANSPs should consider to improve flight plan quality. Current and emerging technologies provide ANSPs and operators with an opportunity to reduce errors associated with filing flight plans and sending movement messages. We recommend that ANSPs should implement automated data transfer systems such as automatic message handling system (AMHS) or aeronautical fixed telecommunication network (AFTN) wherever, and whenever, possible.

Errors and inefficiencies often occur in the transit of aircraft from surveillance to non-surveillance airspace in the vicinity of FIR boundaries due to the lack of robust, bilateral agreements between neighbouring states, incompatible communication technologies, or differences between procedures and airspace classifications. These errors may include applying incorrect longitudinal separation when entering a non-surveillance environment from a surveillance environment; issuing incorrect communications transfer instructions; or not providing sufficient airway width protection for airway structures that exist in neighbouring non-surveillance airspace. These inefficiencies could lead to optimum and desired vertical and/or lateral route profiles not being available to operators during and after the transition across an FIR boundary.

With increasing levels of air traffic, the introduction of surveillance capabilities can provide measurable efficiencies for operations involving aircraft transiting from oceanic areas to higher-volume domestic routes and vice-versa. These efficiencies are especially achieved during the climb and descent phases of flight. In fact, technologies such as automatic dependent surveillance broadcast (ADS-B) and multilateration (MLAT) enable ANSPs to provide surveillance capabilities in non-surveillance areas at a significantly lower cost than conventional modes of surveillance. The provision of space-based ADS-B

by satellite solutions is under development. It will deliver near real-time aircraft position updates anywhere ADS-B equipped aircraft fly, including over oceans and remote regions, creating opportunities where there were limitations in the past.

ANSPs should consider building surveillance capabilities, sharing data, developing regional plans, and the continuation of separations standards and procedures across FIR boundaries as key areas to improve operations in surveillance / non-surveillance environments.

Creating and instituting seamless FIR boundary crossings is an important task with critical implications to both safety and efficiency. As ANSPs gain experience in mitigation strategies and share knowledge and lessons learned, we will move toward a safer, more environmentally friendly, technologically and procedurally interoperable ATM system that delivers a truly seamless airspace environment.

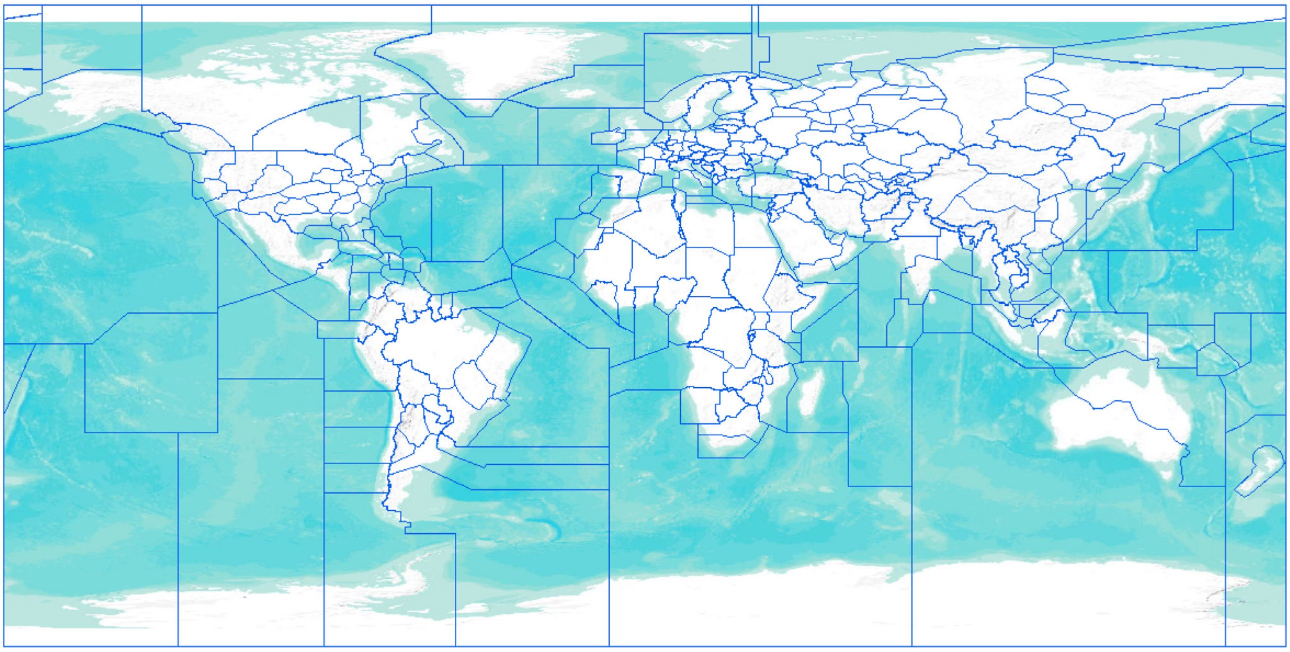
1

Global Flight Information Regions

There are several hundred FIRs that span the globe with differing communication, navigation and surveillance (CNS) and ATM environments in each. CANSO has identified that operational inconsistencies in separation standards and procedures, disparities in flight plan filing procedures, incompatibilities between adjacent automation platforms, and inconsistent airspace structures can negatively impact safety and create inefficiency when aircraft cross these FIR boundaries.

Harmonising CNS and ATM environments across all FIRs, though desirable, is a complex and challenging goal. CANSO believes that the impediments to achieving seamless traffic can be mitigated by developing best practices that can be implemented and used globally.

To achieve harmonised and seamless operations, ANSPs must be aware of the operational capability of neighbouring FIRs. This would not only help planning for system enhancements, but may help foster regional collaboration. Table 1 on the next page illustrates neighbouring FIR capabilities in the Pacific.



Sources: Esri, USGS, NOAA, Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Source: ICAO

Fig. 1. Scope of FIR boundary crossings[1].

[1] Source: http://gis.icao.int/icaoviewernew/#/33.5741/43.4587/2

Table 1.
Pacific Seamless Airspace Capabilities

ANSP		AirNav Indonesia		AFL Ltd	Airservices Australia		Airways NZ	CAAP	CAAS	DGAC	FAA		JANS	PNG ASL	SEAC-PF	FAA					NAV CANADA	SENEAM	DGAC Ecuador
FIR		Jakarta	Ujung Pandang	Nadi	Brisbane (Honiara & Nauru)	Melbourne	Auckland Oceanic	Manila	Singapore	Santiago	Anchorage Oceanic	Oakland Oceanic	Fukuoka	Port Moresby	Tahiti	Anchorage Domestic	Anchorage Arctic	Guam CERAP	Honolulu Control Facility	Oakland Domestic, Seattle and Los Angeles ARTCC	Vancouver ACC	Mazatlan FIR	Guayaquil FIR
RVSM		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Surveillance	SSR	✓	✓		✓	✓	✓	✓	✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	
	ADS-C	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓		✓								
	ADS-B			O	✓	✓			O							✓							
Comm	CPDLC			✓	✓	✓	✓		✓		✓	✓	✓		✓								
	FMC WPR			✓	O	✓			O												✓		
	SCV						✓					✓	✓										
	HFDL						✓					✓											
RNAV/RNP 10	50NM Lateral			✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓	✓	✓	✓		
	50NM Long			✓	✓	✓	✓		✓		✓	✓	✓		✓			✓	✓	✓	✓		
10 Minute Long. NMC				✓	✓	✓	✓		✓		✓	✓	✓			✓		✓	✓	✓	✓		
RNP4	30NM Lateral			✓	✓	✓	✓				✓	✓	✓					✓	✓	✓			
	30NM Long			✓	✓	✓	✓				✓	✓	✓					✓	✓	✓			
ADS-B CDP													O										
ADS-B ITP													✓										
Lateral Offset for Climb & Descent					✓	✓							✓							✓			
UPR				✓	✓		✓			✓	✓	✓	✓	✓	✓					✓			
DARP	Accept			✓	✓		✓					✓	✓		✓			✓	✓	✓			
	Initiate			✓								✓											
AIDC	CPL/EST			✓	✓	✓	✓				✓	✓	✓		✓	✓		✓	✓				
	CDN			✓			✓				✓	✓	✓			✓		✓	✓				
	Weather Deviation			✓			✓				✓	✓	✓		✓								
	Offset			✓							✓	✓	✓										
	Block Level			✓	✓	✓	✓				✓	✓	✓					✓	✓				
	Mach Speed			✓			✓				✓	✓	✓			✓							
	FAN/FCN												✓										
	Forwarding												✓										
Network Optimization	A-CDM											✓			✓					✓			
	En Route CFM												✓							✓			
	ODP Tailored Arrival						O		✓			✓	✓							✓			
	Optmized Climb						O																

2

Flight Planning Quality

The seamless and efficient flow of air traffic across FIR boundaries is achieved, in part, by ensuring that flight plans and associated messages are transmitted, processed, and transferred between FIRs in a seamless and efficient manner.

The methods and procedures used to file and / or originate flight plans impact the quality of the air traffic services rendered. Poor-quality flight planning has been reported[2] as a contributor to increased workload for air traffic controllers due to the increased time required to interact with aspects of the flight plan.

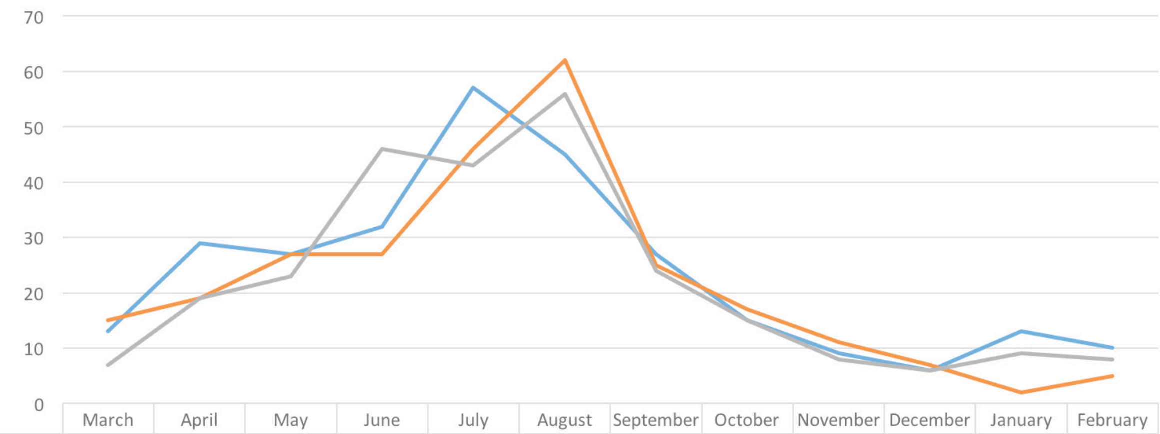
The introduction of duplicate or multiple flight plans, or flight plans containing erroneous information, has a direct impact on the safety and efficiency of flights within the global airspace system. By reducing and/or eliminating duplicate or multiple flight plans and improving the overall quality of flight plans received by ANSPs, controllers are able to reduce real-time corrective action to flight plans, and instead focus on the separation of aircraft, issuing traffic and safety advisories, and disseminating necessary weather information. By mitigating the problem upfront, controllers will spend less time comparing duplicate or multiple flight plans, reconciling disparities, soliciting pilots or adjacent ANSPs to determine flight plan accuracy, or making computer inputs to manually amend erroneous flight plan fields. This will reduce the amount of "heads-down" duties that controllers typically encounter during this mitigation process and will allow them to focus their attention on radar displays or flight progress strips.

The main sources of flight planning errors include issues in the flight plan fields; in the submission, transmission and the processing of the flight plan; alignment of State regulation with emerging technologies; and in proper operator and customer communication, collaboration and feedback[3].

NAV CANADA annually reports on a variety of operational statistics.

[2] Civil Aviation Safety Authority (2014). Airspace Review of Upper Airspace Services (East) and Outback Groups http://www.casa.gov.au/wcmswr/_assets/main/lib100244/airspace_review_upper_east-outback-groups2014.pdf

[3] Based on air safety reports, and global aviation data management from IATA, and the ICAO North American, Central American, Caribbean FPL and Ad Hoc group.



	March	April	May	June	July	August	September	October	November	December	January	February
2012/2013	13	29	27	32	57	45	27	15	9	6	13	10
2013/2014	15	19	27	27	46	62	25	17	11	7	2	5
2014/2015	7	19	23	46	43	56	24	15	8	6	9	8

Source: NAV CANADA

Fig. 2. This graph describes three years of data on trans-border flights where NAV CANADA did not receive a flight plan before the aircraft entered their airspace.

2.1 Flight Plan Fields

Destination Alternate Aerodromes - Some automated ground systems will reject flight plans that do not contain a destination alternate aerodrome, even in cases where one is not required. If the automation system rejects the flight plan then the information is not available to the air traffic control (ATC) unit, which can impact both safety and efficiency. To prevent the flight plan from being rejected, some operators file alternate aerodromes, even when not required, which results in the aircraft carrying additional and unnecessary fuel.

ICAO Annex 6, Operation of Aircraft, Part 2 provides exceptions to the requirements for filing a destination alternate aerodrome. ANSPs should ensure that the destination alternate aerodrome field is not mandatory for the automated processing of flight plans, especially for flights transiting to a destination in another FIR. This should be confirmed when establishing requirements during the design and implementation of a new system. Additionally, ANSPs should undertake the necessary steps to incorporate relevant changes in software and/or adapt existing automation systems to ensure that the alternate destination is not a mandatory field for the flight plan.

Naming of Arrival/Departure Procedures - The naming of arrival and departure procedures varies from State to State; the most common difference is the number of characters used. Some automation systems will reject flight plans containing SID or STAR names that exceed a certain number of alphanumeric characters. ANSPs should ensure that the names for any published SID or STAR procedures permitted to be filed in flight plans comply with the naming requirements of ICAO *Annex 11, Air Traffic Services, Appendix 3*. The name adapted in the ANSP's automation system should be identical to the published procedure listed in the aeronautical information publication (AIP) to reduce the number of flight plan rejections.

ANSPs should ensure that ATM systems are able to correctly process filed flight plans that include SIDs and STARs as part of the route.

ICAO Flight Plan (FPL) 2012 Format Conversions - During the transition to the ICAO Flight Plan 2012 format, converters were used by some ANSPs to convert existing flight plans to the new format. However, the Asia Pacific Air Navigation Planning and Implementation Regional Group meeting in June 2013 (APANPIRG/24) noted the following issues associated with the continued use of converters:

- The benefits of the amendment to *Procedures for Air Navigation Services, Air Traffic Management*, (Doc 4444-ATM/501, Amendment No.1, 15/11/12) could not be realised, particularly reduced separation standards relating to performance-based navigation (PBN), and the provision of ADS-B services (including separation)
- The interoperability of air traffic service inter-facility data communications (AIDC) messaging would remain restricted where converter solutions were in use

Other known issues with the ICAO FPL 2012 identified by APANPIRG/24 included:

- The indicator RVR/ (runway visual range) in Item 18 of the FPL. This indicator should be either accepted without processing, or deleted without rejection by ATM systems
- Rejections of FPL occur if unexpected RMK/ (remark) information is included in Item 18 of the FPL

To reduce erroneous messages from being originated, and to obtain the maximum benefit from the new flight plan format, ANSPs are encouraged to achieve full compliance with the provisions of *ICAO FPL 2012* for automation and supporting systems.

2.2 Flight Plan and Movement Messages

The ATM technology and industry systems have been improved and developed since the paper FPL filing was introduced. The current ATM systems enable the operators and ANSPs to eliminate the time consuming and error-prone manual processes of paper FPL filing.

Direct Transmission of Flight Plan Messages - To reduce the risk of manual input errors, ANSPs may implement local agreements published via aeronautical information circulars (AIC)/AIP that delegate the responsibility to operators for direct transmission of certain movement messages via the AFTN or the AMHS. These movement messages include FPL; modification (CHG); delay (DLA); and flight plan cancellation (CNL) messages.

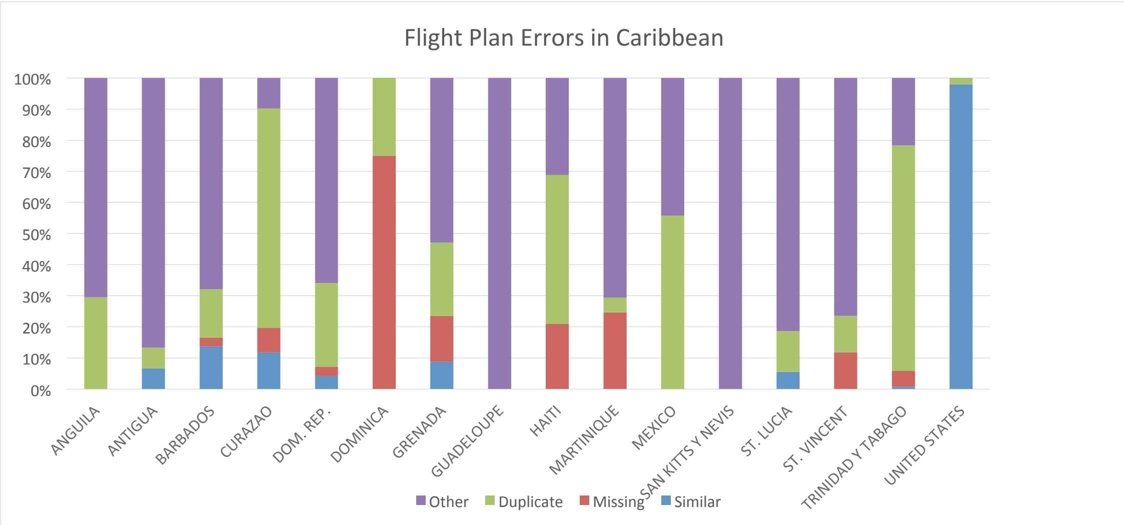
Before delegating responsibility for direct submission of flight plan messages, ANSPs should consider conducting a trial with operators willing to proceed under the specified procedures mentioned on the AIC/AIP using an AFTN/AMHS address to receive the messages for initial manual validation.

During the validation and operational phase, and to avoid confusion by having one single point of coordination to correct possible errors, the ANSPs should consider delegating full responsibility to the operators to:

- Originate the movement messages and the related FPL and send via AFTN/AMHS to all involved ATS units and,
- Distribute the involved movement messages to the concerned FIRs and units according to ICAO's *Procedures for Air Navigation Services Air Traffic Management* (Doc. 4444).

The partial delegation of these responsibilities can lead to confusion when trying to identify the responsible party when ANSPs attempt to amend FPL errors.

The operators that are granted full delegation of responsibility to originate and transmit the FPLs to all involved ATS units (not only to the departing FIR or air traffic service reporting office), must ensure the accuracy of the AFTN addresses for the associated FIRS. If an ANSP does not have the FPL when the flight is crossing its FIR boundary it could result in system inefficiency, airspace deviations, and a compromise to safety.



Source: Federal Aviation Administration

Fig. 3. This chart shows percentages of type of flight plan errors in the Caribbean region

ANSPs should also specify in local agreements or the AIP, any required time limits for completing the submission of movement messages for individual flights, for example, by a time parameter prior to the estimated off-block time (EOBT). We recommend that ANSPs reach a regional consensus and coordinate the time parameter setting to be configured on the ATM systems within the region. This agreed setting will be applied by the flight plan filers to avoid confusion across the different FIRs in the same region.

Repetitive Flight Plans (RPL) - The use of RPL is a major contributor to the introduction of duplicate flight plans and can lead to the provision of less-than-optimum services. The flight plan information contained in the RPL may differ from the intended details for a flight on a particular day, creating confusion and a disparity between the information that the controllers are using to provide services and what flight crews have on their flight management systems. These disparities are generally found in the filed route, aircraft type, speed, filed flight levels, and the avionics capabilities. These inconsistencies impact the situational awareness and planning of both parties, and may also affect flight safety, in part due to erroneous application of separation standards by ANSPs.

The image in figure 4 on the next page depicts a flight that originated in Managua international airport (MNMG) destined for Miami International Airport (KMIA). This flight operated every other day using a B757/200 and once a week the flight operated using a B767/300. On 18 March 2012, the operator filed a flight plan as a heavy B763. That same day, MNMG ATC originated and transmitted a flight plan for the flight using B752/M as the type aircraft with different equipment capabilities. The flight plan filed by MNMG also indicated an erroneous date (16 March 2012) which indicates that a RPL was used when originating the flight plan. As a result, MUFH, KZMA, and KMIA all believed that the aircraft was a medium category aircraft versus a heavy aircraft. KMIA tower controller provided standard separation for aircraft following what they believed to be a B752/M. After visually seeing the aircraft and determining that the flight was operating as a heavy B763, it was apparent that appropriate wake turbulence was not applied and required minimum separation was lost. Additionally, because the erroneous equipment capability was filed, the aircraft was not assigned the appropriate and preferred PBN routing.

Consequently, we recommend that instead of ANSPs using RPLs, that the direct filing of flight plan and related movement messages via the AFTN/AMHS be the preferred method of flight plan submission by operators.

2.3. Processing Flight Plans

Error Mitigation Procedures - Appropriate procedures are necessary for the resolution of issues resulting from messages that are not received. Part of that resolution is to ensure that duplicate or erroneous messages are not introduced into the system. For example, if a movement message is received for an unknown FPL, the receiving ATC unit should use the request flight plan (RQP) message to request the FPL from the sending unit, rather than creating its own FPL. LOAs between ANSPs should include a clear and appropriate FPL message exchange process via AFTN/AMHS to complete the flight transference, without creating a new FPL. When adjacent FIRs are not connected with AIDC or on-line data interchange, this practice should be applied during verbal coordination of flight transference between the ATC units when the receiving ATC unit does not have the FPL.

Where ANSPs provide FPL filing capability via the internet, a validation process should be implemented to prevent the introduction of inaccurate data from movement messages. NAV CANADA provides an example of the use of internet-based flight-plan-filing with use of its collaborative flight planning system (CFPS). The CFPS application allows direct flight plan filing by pilots and/or flight-plan-filing agencies; is fully *ICAO Flight Plan 2012* compliant; and completes front-end error checking that requires FPL filers

Source: Federal Aviation Administration

Fig. 4. Disparate FPL information received by multiple FIRs

to correct discrepancies before the flight plan is accepted for processing.

The ANSPs should consider the flexibility, the number of steps involved, and the human-machine interface for the controller to find and transmit FPLs rapidly, when setting up the specification, requirements and trial protocols, for new or upgraded ATM systems.

AFTN Addresses - To reduce FPL filing discrepancies that result from erroneous addressing of aeronautical messages, ANSPs should list their AFTN addressing requirements in their AIP. Guidance related to the addressing of AFTN messages is also available in ICAO Annex 10, *Aeronautical Communications, Volume II, Chapter 4*, ICAO Docs 7910 and 8585, and ICAO regional AFTN routing directories.

Central Flight Plan Processing Unit - ANSPs with multiple ATS centres may consider implementing a central flight planning unit for the initial processing and distribution of FPLs. An example of central flight planning is provided by the EUROCONTROL initial flight plan (IFPL) specification.

Studies[4] undertaken by EUROCONTROL and the European Commission determined that inconsistencies in the content of flight data held by different parties for the processing of the same flight had a negative impact on the efficiency of operations within the European air traffic management system.

According to EUROCONTROL[5] the IFPL specification defines the "procedures and requirements for the provision, processing and distribution of flight plans in the pre-flight phase". The improvement of the consistency of flight-planning data between aircraft operators, air traffic flow and capacity management, and ANSPs has contributed to seamless operations and enhanced safety.

2.4. Review of State Regulations

The process of submitting a flight plan is promulgated by ANSPs through AIPs or civil aviation requirements. Though a growing number of ANSPs now allow electronic submission of flight plans, some ANSPs are still bound by State regulations which require operators to submit paper copies of flight plans to ATC units.

ANSPs are encouraged to partner with the State regulators to review existing regulations to reconcile conflicting policy and regulations and align them with emerging technologies. An example where opposing regulations is a causal factor in flight plan duplication exists along the southern United States FIRs (Miami and San Juan). The U.S. AIP instructs operators to address FPLs to the first domestic U.S. en route centre while *ICAO Doc 4444* specifies that FPL messages shall be originated and addressed by the ATS unit serving the departure aerodrome. These differing procedures cause both operators and ATS units to transmit FPLs messages for the same flight to the same en route centre, resulting in the duplication of FPLs. In cases where State regulations require hand-delivered FPLs in conjunction with electronic FPLs, the amendment of such regulations may reduce human-induced discrepancies in the filing process and the resulting issues for both safety and efficiency.

If, following a review, State regulations still require operators to hand-deliver filed flight plans, ANSPs should ensure that robust quality control measures are implemented. These quality control measures should stipulate procedures for comparing and reconciling hand-delivered FPLs and the associated electronic copies to reduce the likelihood of disparity between different versions of the same flight plan.

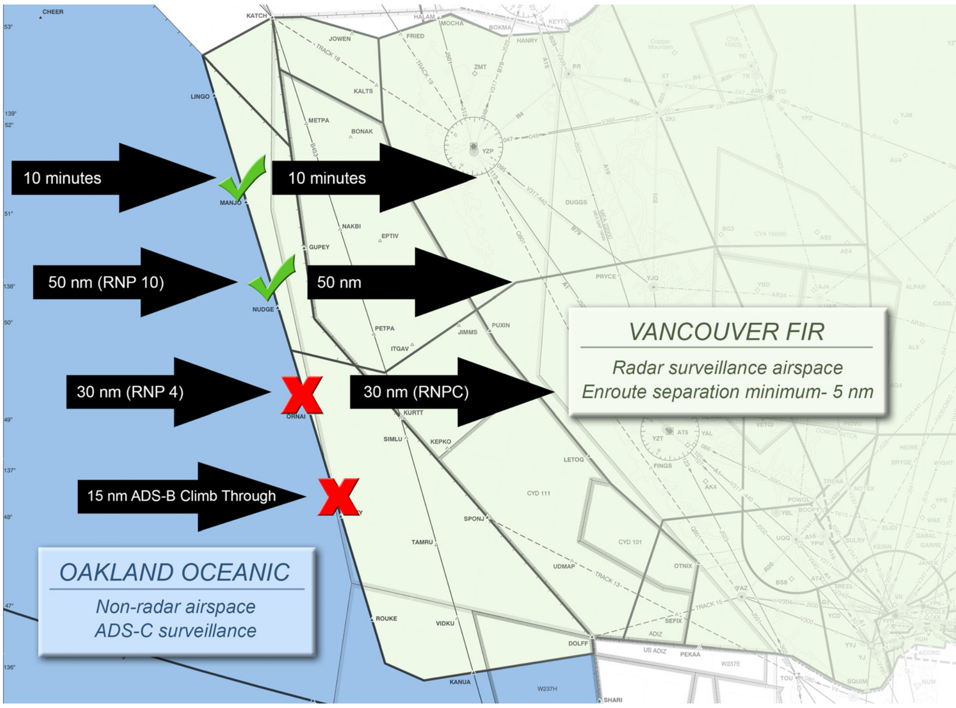
2.5. Communication, Collaboration and Coordination

A cooperative regional framework and coordinated agreements for seamless airspace is achieved through communication, collaboration, and coordination between neighbouring FIRs. Sharing flight plan information, procedures, and system enhancements are essential to provide seamless crossings of FIR boundaries, and will become ever more so with increasing numbers of operations and the associated developing complexity.

Effective communication, collaboration, and coordination can lead to regional gains such as initiating seamless ATM plans. An example of how seamless ATM plans benefit ANSPs regionally is in seamless airspace charts such as the one in the Asia/Pacific Seamless ATM Plan.

[4] EUROCONTROL Specification for the Initial Flight Plan (IFPL) - EUROCONTROL-SPEC-0101

[5] https://www.eurocontrol.int/articles/initial-flight-plan-ifpl-specification



Source: NAV CANADA, Vancouver FIR

Fig. 5. Illustrates the opportunity for improved customer service through communication, collaboration and coordination by neighbouring FIRs.

The figure above helps to understand the various longitudinal separation between successive flights as they cross Oakland oceanic airspace into the radar surveillance airspace of Vancouver FIR. The longitudinal separations reduce from 10 minutes in a conventional environment to 50 nautical miles (NM) with RNP 10 capability to 30 NM with RNP4 capability due to the use of automatic dependent surveillance–contract (ADS-C) surveillance. The longitudinal separation can further reduce to 15NM when served by ADS-B surveillance.

A study, *Identification of Communication and Coordination Issues in the U.S Air Traffic Control System*, by Davison and Hansman (2001), found that communications are critical to the air traffic management system and that opportunities exist for increased communications and collaboration, both within a centre and with external agencies. The study concluded that technical, organisational, and social improvements can together improve the efficiency of the ATM system and should be considered a high priority.

Technical improvements can involve the replacement of manual systems with electronic systems, such as terminals or communication links for the direct filing of flight plan messages via the AFTN/AMHS or internet/web interfaces.

Organisational improvements can involve changes and improvements to training regimes and the introduction of more efficient routes, traffic flows, and procedures across FIR boundaries.

ANSPs should consider establishing a reporting mechanism to provide regular feedback to operators on the number and causes of flight plan rejections and errors. For example:

- Erroneous information in ICAO FPL fields
- Incorrect refiling of FPLs in lieu of the appropriate use of movement messages (CHG, DLA, etc.)
- Missing FPLs

Additionally, ANSPs should consider holding periodic forums with the users and operators to discuss recurring discrepancies, and to actively investigate and resolve cross-boundary errors with neighbouring FIRs to reduce ATM errors. The United States Federal Aviation Administration (FAA) routinely partners with IATA, Airlines for America, National Business Aviation Association and others to jointly facilitate these forums.

3

Surveillance versus Non-Surveillance

To foster a continuous and seamless transition across FIR boundaries it is important that similar procedures, services, and separation standards are used by adjacent FIRs. This can best be achieved by ensuring surveillance handoffs when flights cross FIR boundaries. This enables greater access to efficient lateral and vertical profiles. Moreover, the safety levels in a continuous surveillance environment are higher than those in a procedural environment.

One of the main impediments to achieving appropriate efficiency is that surveillance services are often terminated prior to the boundary, and then a procedural handoff is used to transfer the aircraft to the receiving ATC facility.

There are two major contributing causes to this situation:

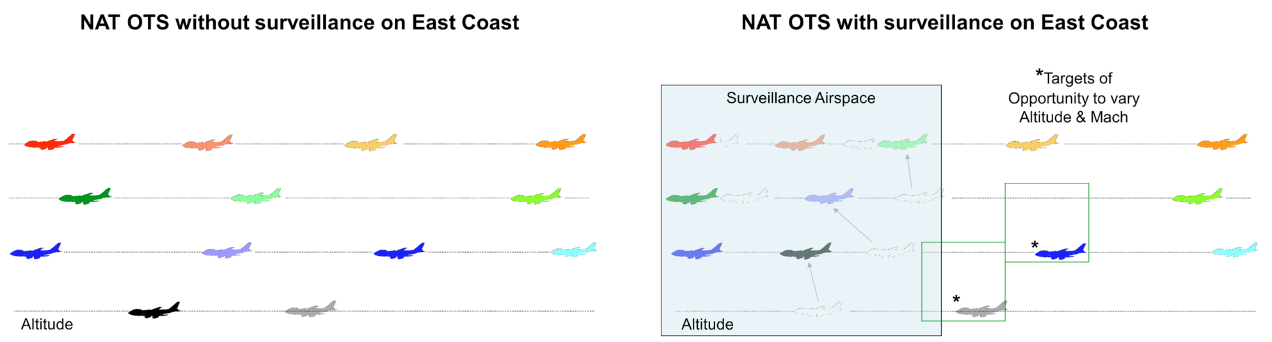
- Although surveillance services are provided on both sides of the FIR boundary, the technological and procedural limitations require procedural handoffs of traffic across the boundary.
- Surveillance capability does not exist on the receiving side of the FIR boundary, due to the lack of appropriate or operational equipment, or due to geographical limitations, such as oceanic or remote airspace.

The best practices in this section relate to both of these cases and are divided into the following classifications:

- Building surveillance capabilities
- Continuation of surveillance separation standards and procedures across FIR boundaries
- Crossing FIR boundaries from a surveillance to a non-surveillance environment
- Common best practices for surveillance versus non-surveillance environments

3.1. Building Surveillance Capabilities

When building the surveillance capabilities near FIR boundaries the administrative authorities of contiguous FIRs should collaborate to identify and minimise gaps in surveillance coverage and to ensure compatible technology and procedures are in place.



Source: NAV CANADA

Fig. 6. Illustrates optimised flight levels through the use of surveillance capabilities.

Within the NAT OTS airspace, emphasis has been placed on improved customer service achieved through use of advances in surveillance capabilities. These advances enable ANSPs to accommodate more flights at optimum cruising altitudes, enhancing efficiency for the ANSP and its customers.

3.1.1. Increasing Surveillance through New Technology

ICAO has identified ADS-B and MLAT as appropriate systems for the application of surveillance-based separation between aircraft (2014). A major benefit of these systems over traditional primary and secondary radar installations is that they are generally less expensive to install and maintain, while providing similar levels of surveillance coverage. According to Darrow (2014)[6], ADS-B can provide surveillance services at up to one-twentieth the cost of an equivalent radar installation. ADS-B and MLAT can be shared between States with appropriate equipage and agreements. According to Airservices Australia (2012), they are able to provide surveillance capabilities in non-surveillance areas that are within sufficient proximity of the installations at a lower cost than conventional modes of surveillance.

In 2005, the FAA conducted a cost comparison analysis to determine what surveillance capabilities would be the most cost effective method to increase existing surveillance coverage, and to provide surveillance in areas where coverage currently does not exist. The three options explored and evaluated were ground based surveillance radar, wide area multilateration (WAM), and Automatic Dependent Surveillance Broadcast (ADS-B). ADS-B was selected in large part because of the cost savings as indicated in Table 2 below.

Some ANSPs have used ADS-B and MLAT to increase surveillance coverage in areas that have traditionally been non-surveillance areas, thereby reducing constraints for flights crossing, or transiting close to, FIR boundaries. ICAO reports[7] that during the Gulf of Mexico (GOMEX) Route Redesign project, en-route control centres and an airline participated in an ADS-B route test in the GOMEX airspace. The objective of this test was to determine if benefit could be gained by using ADS-B routes during periods of adverse weather or other limiting conditions. The results demonstrated an increase in efficiency and cost savings to the user, and indicated that benefit would be gained from further implementation of ADS-B in GOMEX airspace.

Providing surveillance data to controllers in remote airspace realises the following benefits:

Cost	Type of surveillance		
	Radar	**WAM**	**ADS-B**
Acquisition and Implementation	USD 7 - 10M	USD 5 - 6M	USD 600K - 1M
Annual Operations	USD 200 - 300K	USD 200 - 300K	USD 125K

Table 2. Cost Relative to Surveillance Type

[6] New better-than-radar technology will boost aircraft tracking, April 2014. https://gigaom.com/2014/04/08/new-better-than-radar-technology-will-boost-aircraft-tracking

[7] NACC/WG-IP/30, Fourth North American, Central American and Caribbean Working Group Meeting, March 2014

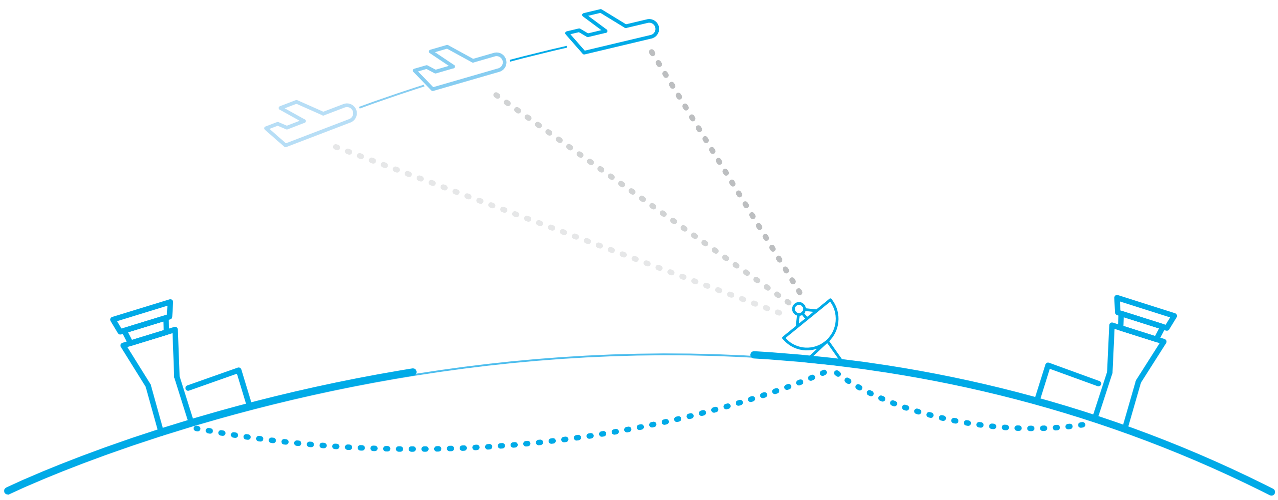
— The minimum separation between aircraft can be reduced from up to 30 NM to as little as 5 NM, with a commensurate increase in airspace capacity
— With no need for voice position reports there are fewer air to ground communications
— There is improved tactical operational flexibility for controllers and pilots e.g. direct tracking and vectoring
— Controllers may be provided with 'safety net' alerting tools, e.g. short term conflict alert.

The FAA has also made use of ADS-B through the third-party installation of ADS-B ground stations. Airports Authority of India (AAI) has completed the installation of twenty one ADS-B receivers to complement existing RADAR installations and ensure that the entire continental airspace of India is under full surveillance coverage. The process of regulatory approvals is currently under progress.

ANSPs are encouraged to implement ADS-B in applicable airspace in accordance with the requirements of the ICAO Aviation System Block Upgrades (ASBU) to provide optimal services to airspace users. ASBU Module N° B0-ASUR: Initial capability for ground surveillance contains information on surveillance capability provided by ADS-B and other alternative technologies.

3.1.2. Sharing Surveillance Data

It is possible to share surveillance data with modern ATM systems. Shared surveillance data can provide additional situational awareness, or can be used to provide surveillance services using third-party data. This type of operation can assist in mitigating issues, such as incorrect coordination, or discrepancies in situational awareness across airspace boundaries, arising during the transition from traditional non-surveillance airspace to surveillance airspace and vice versa.



Source: Airservices Australia

Fig. 7. Surveillance data from a ground receiver is transmitted for use by ATC centres of two different FIRs that enables continuous surveillance of the flight as it crosses the FIR boundary.

ADS-B data from the Timor Sea is currently shared between Airservices Australia and AirNav Indonesia to improve controller situational awareness. While a surveillance separation service is not provided in this case, controllers use the surveillance data to apply non-surveillance separation, which provides the following direct benefits to controllers and operators:

- Situational awareness is improved because controllers can readily observe tracks for route and flight level accuracy, and gauge boundary estimates of inbound/outbound traffic without having to communicate with the flight crew.
- Voice position reports are not needed and result in fewer air/ground communications
- Coordinated information can be cross-checked against observed surveillance data, which can reduce the likelihood of incorrect coordination and ensure that flight plan data is consistent between FIRs.

A number of other ANSPs in the Asia Pacific Region are, or are planning to share ADS-B data across FIR boundaries.

ICAO has made available:

- A letter of agreement template for the sharing of ADS-B data between ANSPs: *Sample Agreement for the Standard Use of ADS-B*; http://www.icao.int/_layouts/download.aspx?SourceUrl=/APAC/Documents/edocs/cns/sampleagreementrev.doc
- *ICAO ADS-B Implementation and Operations Guidance Document*; http://www.icao.int /APAC/Documents/edocs/cns/ADSB_AIGD7.pdf
- Report and Working/Information Papers from the 11th ADS-B Study and Implementation Task Force Meeting; http://www.icao.int/APAC/Meetings/2012_ADS_B_SITF_11 / WP16_AUS%20AI.6%20Success%20of%20data%20sharingV3.pdf
- Planning for Global Aviation Safety Improvement, Information Paper, IP HLSC/15-IP/38; http://www.icao.int/Meetings/HLSC2015/Documents/IP/ip038 _en.pdf

3.2. Continuation of Surveillance Separation Standards and Procedures across FIR Boundaries

If the surveillance capabilities exist on both the sides of the FIR boundary, then surveillance services and separation standards should be continued when the flight crosses the FIR boundary to optimise airspace capacity and flight efficiency.

3.2.1. Coordination Procedures

Often the lack of an established bilateral surveillance operation across FIR boundaries can result from the lack of adequate landline communications required to enable procedural hand-offs in a non-automated environment.

ANSPs are encouraged to pursue the implementation of reliable communication in these instances to accommodate bilateral surveillance operations.

Suggested communication methods, in decreasing order of reliability:

- Dedicated communications line (e.g. trunk line)
- International direct dial telephone with voice switching systems able to queue calls
- Dedicated fixed line telephone number for each neighbouring FIR
- Dedicated mobile phone for each neighbouring FIR.

3.2.2. Aligning Procedures and Standards

Wherever possible, adjacent ANSPs should ensure that the procedures and separation standards used on both sides of a FIR boundary are aligned so that there are no changes to procedures or levels of service during the transition. Migrating from region-specific standards (e.g. Australian Area Navigation Operations) to internationally recognised PBN standards, e.g. area navigation 5 (RNAV 5), will help align separation standards with adjoining FIRs.

When applying separation standards for crossing FIR boundaries, the optimum standards for the airspace classification should be implemented to provide the maximum benefit to the operators. Providing the minimum required separation standards for a given pair of aircraft across an FIR boundary allows for the optimal flow of traffic through the airspace, and therefore increases efficiency while reducing fuel burn and CO_2 emissions. However, when implementing a reduction in separation standards, ANSPs need to consider the impact and requirements on safety management systems, LOAs, and airborne and ground-based capabilities.

The following sources provide additional information:

- *Performance-Based Navigation: Best Practice Guide for ANSPs*, CANSO, March 2015
  - Provides PBN implementation guidance and addresses key areas of knowledge, regulations, fleet equipage, resources, and training.
- ICAO Doc 9924 and Circular 326
  - Describes the requirements of an ATS surveillance system including RADAR, ADS-B and MLAT; all of these technologies may be used to provide a surveillance service using the ICAO PANS ATM Doc 4444 separation minima.
- ICAO Doc 9613
  - Details PBN and provides guidance for implementation of non-surveillance procedures using various forms of PBN.
- ICAO PANS ATM Doc 4444
  - Details separation standards

3.3. Crossing FIR Boundaries from a Surveillance to Non-Surveillance Environment

When a flight transitions from surveillance to non-surveillance airspace the required longitudinal separation between that flight and a preceding flight at same flight level may increase significantly. In some cases the minimum longitudinal separation in non-surveillance airspace can increase from 5 NM up to 120 NM, or 15 minutes. When the transition between surveillance and non-surveillance airspace occurs at a FIR boundary the different ATM automations system, required navigation performance (RNP)/ RNAV specifications, airspace classifications, airspace structure, and communications systems result in a significant increase in minimum separation standards.

When flights cross from a surveillance FIR to non-surveillance FIR, the impact on a seamless transfer is much greater, as the only option is to discontinue surveillance services and apply procedural separation.

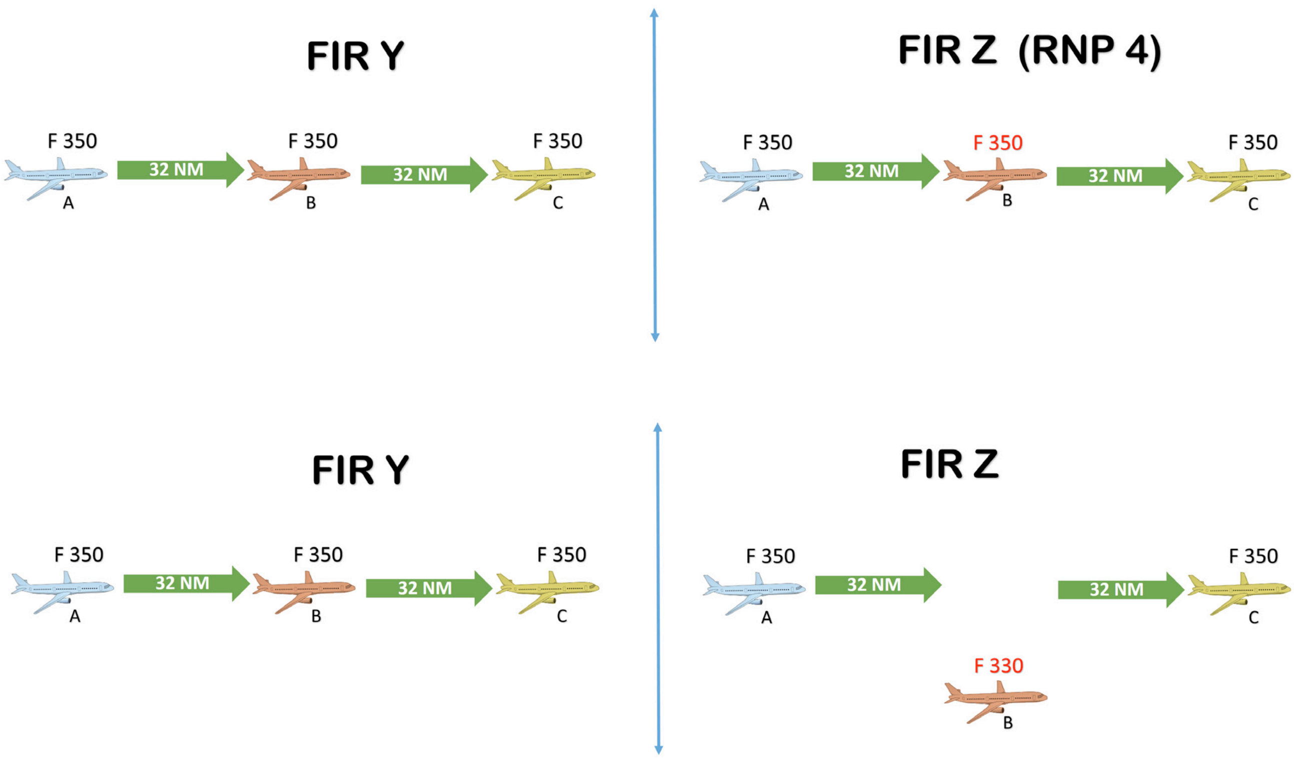
The problem gets further compounded if the accepting FIR has not received the flight plan or has received an incomplete flight plan. The flight plan provides information about navigation and communication and surveillance equipage that ATC uses to provide optimum separation standards, and to facilitate efficient lateral profiles such as user preferred routes (UPR) and dynamic airborne rerouting procedures (DARP).

A UPR is a flight plan created and filed by an airline that provides the specific flight with optimised access to the most efficient en-route weather as determined by the airline's own flight planning system, rather than flying on the fixed route structure. Many of the filed waypoints are, therefore, basic latitude and longitude coordinates.

A DARP is a request from an aircraft for a more efficient route, based on the airline's calculation that, if approved by ATC, will commence at a defined point ahead of the aircraft on the current flight plan. Participating ANSPs often require operators to ensure that an aircraft operating on a UPR or a DARP will re-join the fixed route structure at a defined location.

Take an example of three flights A, B, and C cruising at the same optimum flight level of 35,000 feet (FL350) with a longitudinal separation of 32 NM each in a FIR "Y" with surveillance capabilities. The flights then cross over to a non-surveillance RNP-10 FIR "Z" which uses controller-pilot data link communications (CPDLC) for applying 50 NM longitudinal separation. Flight B will not have the required 50NM separation with either flight A or flight C and would have to amend altitude to a non-optimum flight level e.g., FL330.

These issues can be mitigated by applying the recommended practices provided in this document, which would make it possible for all the three flights to transition from a surveillance-capable FIR to a non-surveillance FIR without a flight level change.



Source: Airports Authority of India

Fig. 8. Crossing from a surveillance to a non-surveillance FIR results in reduced efficiency.

3.3.1. Regional Plans

Where ICAO regional plans are published, ANSPs are encouraged to implement their recommendations to ensure that the entire region can benefit from the improvements to CNS/ATM contained within these plans. An example is the regional implementation of separation standards based on RNP-4 in the Asia Pacific region.

In addition to implementing recommendations from ICAO regional plans, it is also necessary to ensure harmonisation across adjacent ICAO regions based on traffic flows.

The Arabian Sea Indian Ocean ATS Coordination Group (ASIOACG) provides an example of cooperation between individual ANSPs and across ICAO regions to achieve a standard regional 'baseline' for procedural separation standards. Table 3 below shows the strategic plan of ASIOACG partners for the implementation of standard and uniform procedural separation.

The following sources provide additional information on the regional plans:

— *ICAO Asia/Pacific Seamless ATM Plan*; http://www.icao.int/APAC/Documents/edocs/Asia Pacific Seamless ATM Plan V1.0.pdf

ASIOACG/9 INSPIRE/5 report; http://www.inspire-green.com/wp/wp-content/uploads/2015/02/The-ASIAOC9-INSPIRE5-report-2.pdf

3.3.2. RNP-4 and Data Link Implementation

Considering the widespread availability of ADS-C and CPDLC on modern aircraft, ANSPs should consider introducing RNP-4 airspace to cater to high traffic volumes. In conjunction with aircraft using CPDLC and ADS-C, RNP-4 allows the 30/30 NM separation standard to be implemented in non-surveillance, oceanic and remote airspace.

3.4. Best Practices for Surveillance versus Non-Surveillance Environments

Differing separation standards and procedures may apply to air traffic transitioning between surveillance environments and adjoining non-surveillance environments. Inconsistent situational awareness can also develop on either side of airspace boundaries where one ANSP is receiving continuously updated position information from surveillance, and the other ANSP is relying on voice position reporting from aircraft or neighbouring units. Equivalent adjoining airspace classification can assist in the application of consistent procedures, and inter-facility data communications can help to promote shared knowledge and situational awareness.

Year	RNP Status of ASIOACG airspace	Horizontal separation Lateral/Longitudinal
2015	RNP 10	50/50 Nm
2016	RNP 4	30/30 Nm
2020	RNP 2	20/20 Nm

Source. ASIOG/9 INSPIRE/5 Report

Table 3. Plan for Implementation of Reduced Horizontal / RNP Separation Standards in Arabian Sea Indian Ocean Airspace

3.4.1. Airspace Classification

To provide seamless services, it is imperative that contiguous airspace with high-volume traffic flows have the same classifications. ANSPs are encouraged to include contiguous airspace design[8] as an agenda item during bilateral LOA negotiations and meetings.

3.4.2. Automation Interface

AIDC is a key enabler for providing reduced separation standards and efficient flight trajectories across FIR boundaries. Examples of optimised flight trajectories (based on forecast winds) include UPR and DARP, which generally also provide laterally-separated routes that allow the individual aircraft better access to preferred operating levels, resulting in a tangible reduction of CO_2 emissions and operator fuel burn.

AIDC and the *North American (NAM) Common Coordination Interface Control Document* (ICD) facilitate the transfer of current flight plan (CPL) data via automation and are examples of valuable tools that ensure the accurate and consistent CPL data across boundaries.

The data exchange of CPL information using the NAM ICD generally occurs in airspace volumes where bilateral surveillance operations exist. Currently, this is the automation protocol used by the FAA to interface with ANSPs such as NAV CANADA, Instituto de Aeronáutica Civil de Cuba (IACC), and Mexican Airspace Navigation Services (SENEAM). The Instituto Dominicano de Aviación Civil (IDAC) and the FAA are also implementing automation interface using the NAM-ICD protocol.

Additionally, AIDC and NAM ICD contribute to a reduction in controller workload since verbal coordination and manual strip marking is reduced. An example of this can is seen in Table 4 below, which depicts the success rate of CPL transfers between Miami Air Route Traffic Control Center (KZMA) and Havana Area Control Center (MUFH) on 12 April 2015.

ANSPs are encouraged to implement automation interface with adjacent FIRs to supplement or replace manual voice coordination. Where these automation capabilities have been implemented, its use for air traffic coordination should be accomplished through agreed regional interface control documents, and supported by LOAs. To gain the greatest benefits, ANSPs should also ensure that the version of AIDC or NAM ICD implemented in a region is compatible, and preferably the current version.

Current Flight Plan	Logical Accept Message	Logical Reject Message	Percentage
KZMA - MUFH 518	MUFH - KZMA 491	MUFH - KZMA 27	94,7
KZMA - MUFH 441	MUFH - KZMA 436	5	98,8
959	927	5	96,6

Table 4. CPL Success Rate

[8] ICAO Annex 11, Chapter 2, Appendix 4

4

Conclusions and Recommendations

Improvements in the areas of cross-boundary coordination, harmonisation, collaboration, communications, and integrated systems will drive benefits for the aviation industry as a whole. These benefits may include reducing the number of air traffic incidents, improving the flow and accuracy of information, and improvements in flight optimisation by reducing overall flight times, fuel-burn, CO_2 emissions, and the associated workload of operators and airspace users.

There are a number of areas where relatively small changes can have a positive impact on improving efficiency and safety when a plane crosses a FIR boundary, such as the alignment of procedures, separation standards, and airspace classifications on either side of the boundary. The fewer the changes required by flight crews when crossing a FIR boundary, the greater the contribution to the safety and efficiency of the flight.

However, the best method for improving the efficiency and safety of flights transiting from one ANSP to another is the timely introduction of appropriate flight planning practices, procedures, and processes, as well as surveillance and communications technologies. Robust procedures, practices, and processes will be critical regardless of whether the purchase and installation of new technology is performed by States individually, or by States acting as part of a regional or neighbouring collective to realise the benefits of shared technology.

Improved relationships between operators, both within a facility and between units and agencies, can be facilitated by visits to neighbouring facilities to familiarise with, and to understand the issues and restrictions faced by counterparts and stakeholders on the other end of communication links.

With the prospect of increasing traffic levels over the next few decades, mitigating the issues that have been identified within this guide as known causes of errors and inefficiencies will increase the ATM system's ability to meet the global challenges and economic benefits of elevated traffic volumes.

References

1. **Airservices Australia (2012).** *Automatic Dependent Surveillance – Broadcast* (ADS-B) http://www.airservicesaustralia.com/wp-content/uploads/14-150FAC_ADS-B_WEB.pdf

2. **Civil Air Navigation Services Organisation (2015).** *Performance-Based Navigation: Best Practice Guide for ANSPs*. https://www.canso.org/performance-based-navigation-best-practice-guide-ansps

3. **Civil Aviation Safety Authority (2014).** *Airspace Review of Upper Airspace Services (East) and Outback Groups*, July 2014, viewed 8 April 2015, http://www.casa.gov.au/wcmswr/_assets/main/lib100244/airspace_review_upper_east-outback-groups2014.pdf

4. **Darrow. B. (2014).** New better-than-radar technology will boost aircraft tracking, April 2014. https://gigaom.com/2014/04/08/new-better-than-radar-technology-will-boost-aircraft-tracking

5. **Davison, H. J., Hansman, R. J. (2001).** *Identification of Communication and Coordination Issues in the U.S Air Traffic Control System*, Report No. ICAT-2001-2, June 2001, MIT International Center for Air Transportation.

6. **EUROCONTROL,** *Initial Flight Plan (IFPL) Specification***.** https://www.eurocontrol.int/articles/initial-flight-plan-ifpl-specification

7. **EUROCONTROL (2009).** *IFPS and Flight Planning* [Presentation slides]. http://www.acac.org.ma/ar/Workshop%20Presentation/IFPS%20in%20Flight%20PlanningV4.pdf

8. **International Civil Aviation Organization**, *Aeronautical Surveillance Manual* (Doc 9924).

9. **International Civil Aviation Organization**, *Annex 6, Operation of Aircraft*, Part 2, para. 2.2.2.3.5.

10. **International Civil Aviation Organization**, Annex 10, *Aeronautical Telecommunications, Volume II*, Chapter 4.

11. **International Civil Aviation Organization**, Annex 11, *Air Traffic Services*, Chapter 2, Appendix 3, and Appendix 4.

12. **International Civil Aviation Organization**, *Circular 326 AN/188, Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation.*

13. **International Civil Aviation Organization**, *Designators for Aircraft Operating Agencies* (Doc 8585).

14. **International Civil Aviation Organization**, *Location Indicators* (Doc 7910).

15. **International Civil Aviation Organization**, *PANS ATM*, (Doc 4444), para. 11.2.1.1.1.

16. **International Civil Aviation Organization**, *Performance-based Navigation (PBN) Manual* (Doc 9613).

17. **International Civil Aviation Organization** (2007), *AFTN Routing Directory, Asia and Pacific Regions*, 27th Edition.

18. **International Civil Aviation Organization** (2007), Asia/Pacific Regional Interface Control Document (ICD) For ATS Interfacility Data Communications (AIDC), Version 3.0.

19. **International Civil Aviation Organization** (2013), Aviation System Block Upgrades the Framework for Global Harmonization. http://www.icao.int/sustainability/Documents/ASBU.en.Mar.%202013.pdf

20. **International Civil Aviation Organization** (2012, 24 April). *Automatic Dependent Surveillance-Broadcast Seminar and Eleventh Meeting of Automatic Dependent Surveillance-Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SITF/11), Working Paper ADS-B SITF/11-WP/16* (presented by Australia and Indonesia).

21. **ICAO North American (NAM) Common Coordination Interface Control Document (ICD) VOLUME 1:** Area Control Center (ACC) to ACC (2012). http://www.icao.int/NACC/Documents/eDOCS/CNS/NAM%20ICD%20Ver%20D%2020%20Jan%202012.pdf

22. **International Civil Aviation Organization** (2013), *Asia/Pacific Seamless ATM Plan*, Version 1.0. http://www.icao.int/APAC/Documents/edocs/Asia%20Pacific%20Seamless%20ATM%20Plan%20V1.0.pdf

23. **International Civil Aviation Organization** (2013, 30 October-1 November). *The Ninth Meeting of the Southeast Asia and Bay of Bengal Sub-Regional ADS-B Implementation Working Group (SEA/BOB ADS-B WG/9), ADS-B Mandates in the South China Sea.* http://www.icao.int/APAC/Meetings/Pages/2013-SEABOB-ADSB-WG9.aspx

24. **International Civil Aviation Organization** (2014, 2 July), *AFI Planning and Implementation Regional Group Extraordinary Meeting* (APIRG/EO), IP/05

25. **International Civil Aviation Organization** (2015, 2-5 February). *Second High-level Safety Conference 2015 (HLSC 2015) Planning for Global Aviation Safety Improvement, Information Paper HLSC/15-IP/38* (presented by Indonesia).

26. **U.S. AIP ENR 1.11**, *Addressing Guidance* 2.4

Annex A

Identified FIR Boundary Crossing Discrepancies

Below is the list of boundary crossing discrepancies identified by CANSO Members and the FIRBX Task Force. They are categorised by technical and equipment, operational, and procedural issues, and as high (H), medium (M), or low (L) priority depending on the impact to safe and efficient boundary crossings. This list was initiated by Members during workshops conducted during the 5th CANSO Global ATM Operations Conference, March 2014, and the CANSO Latin Caribbean Regional Conference, December, 2014. The FIRBX TF added to the initial lists.

- **Technical and Equipment:**
  - Automation platform incompatibility (H)
  - Automation interface protocol (H)
  - FIR weather sharing with adjacent ANSPs (L)
  - ANSP communication transfers: voice and data-link (M–H)
- **Operational:**
  - Incompatible procedures: requirements of neighbouring ANSPs do not coincide (M)
  - Strategic and tactical ATFM (M)
    - Lack of regional implementation
    - Lack of coordination of ATFM restrictions with adjacent ANSPs
    - Incompatible ATFM plans
  - Language proficiency impacting coordination (L)
  - Global separation standards (L)
    - Time-based (standardise the minima)
    - Reduced longitudinal dependent upon aircraft equipage (ADS-C, CPDLC)
  - Incompatible airspace design (L-M)
    - Stratum of adjacent FIR
    - May cause less than optimal rate of climb or descent for aircraft in close proximity to FIR boundary
  - Bilateral and multilateral boundary location requires additional coordination
    - Need to involve several ANSPs for "point-out" coordination
    - Potential of aircraft leaving and re-entering FIRs over short time periods may lead to ineffective coordination
    - Political issues that impact operation
- **Procedural:**
  - Metric versus imperial measurement of altitude (L)
  - Sharing of situational awareness (e.g., weather, temporary flight restrictions, ATFM restrictions) (L-M)
  - Altimeter Setting: QNE versus QNH (M)
  - Transition altitude: Flight level and altitude (L)
  - RVSM to non-RVSM coordination (L)
  - Coordination procedures: Manual versus automated (H)
  - Pilot/aircraft certification and capability (H)
    - Appropriately entered in FPL
    - ANSP: Appropriately preserved in CPL
  - Pilot/controller human error issues (H)
    - Read-back/hear-back errors
    - Manual coordination
    - Uplink and downlink messages, computer inputs, etc.

Acronyms

AAI	Airports Authority of India
ACI	Airports Council International
ADS	Automatic dependent surveillance
ADS-B	Automatic dependent surveillance-broadcast
ADS-C	Automatic dependent surveillance-contract
AFTN	Aeronautical fixed telecommunication network
AIC	Aeronautical information circulars
AIDC	ATS inter-facility data communication
AIP	Aeronautical information publication
ANSP	Air navigation service provider
AMHS	Automatic message handling system
APAC	Asia Pacific
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
ASBU	Aviation System Block Upgrades
ASIOACG	Arabian Sea Indian Ocean ATS Coordination Group
ATC	Air traffic control
ATFM	Air traffic flow management
ATM	Air traffic management
ATS	Air traffic service
CANSO	Civil Air Navigation Services Organisation
CFPS	Collaborative flight planning system
CHG	Modification message
CNL	Flight plan cancellation message
CNS	Communication, navigation and surveillance
CPDLC	Controller pilot data link communication
CPL	Current flight plan
DARP	Dynamic airborne reroute procedure
DLA	Delay message
EOBT	Estimated off block time
FAA	United States Federal Aviation Administration
FIR	Flight Information Region
FIRBX	CANSO FIR Boundary Crossings Task Force
FL	Flight level
FPL	Filed flight plan
IACC	Instituto de Aeronáutica Civil de Cuba
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization

ICD	Interface control document
IDAC	Instituto Dominicano de Aviación Civil
IFPL	Initial flight plan specification (EUROCONTROL)
ISPACG	Informal South Pacific ATS Coordinating Group
KMIA	Miami International Airport
KZMA	Miami Air Route Traffic Control Center
LAM	Logical accept message
LRM	Logical reject message
LOA	Letter of agreement
MLAT	Multilateration
MNMG	Managua International Airport
MUFH	Havana area control centre
NM	Nautical miles
OSC	CANSO Operations Standing Committee
OTS	Organised Track System
PBN	Performance-based navigation
QNE	The altimeter sub-scale setting to obtain elevation when on the ground
QNH	Air pressure at mean sea level in the International Standard Atmosphere (ISA)
RMK	Remark
RNAV	Area navigation
RNP	Required navigation performance
RPL	Repetitive flight plan
RQP	Request flight plan message
RVR	Runway visual range
RVSM	Reduced vertical separation minima
SID	Standard instrument departure
STAR	Standard terminal arrival
UPR	User preferred route

CANSO Members

CANSO – the Civil Air Navigation Services Organisation – is the global voice of air traffic management (ATM) worldwide. CANSO Members support over 85% of world air traffic. Members share information and develop new policies, with the ultimate aim of improving air navigation services (ANS) on the ground and in the air.

CANSO represents its Members' views to a wide range of aviation stakeholders, including the International Civil Aviation Organization, where it has official Observer status. CANSO has an extensive network of Associate Members drawn from across the aviation industry. For more information on joining CANSO, visit www.canso.org/joiningcanso.

canso
civil air navigation services organisation

Full Members - 89

— Aeronautical Radio of Thailand (AEROTHAI)
— Aeroportos de Moçambique
— Air Navigation and Weather Services, CAA (ANWS)
— Air Navigation Services of the Czech Republic (ANS Czech Republic)
— AirNav Indonesia
— Air Traffic & Navigation Services (ATNS)
— Airports and Aviation Services Limited (AASL)
— Airports Authority of India (AAI)
— Airports Fiji Limited
— Airservices Australia
— Airways New Zealand
— Albcontrol
— Austro Control
— Avinor AS
— AZANS Azerbaijan
— Belgocontrol
— Bulgarian Air Traffic Services Authority (BULATSA)
— CAA Uganda
— Cambodia Air Traffic Services Co., Ltd. (CATS)
— Civil Aviation Authority of Bangladesh (CAAB)
— Civil Aviation Authority of Botswana
— Civil Aviation Authority of Mongolia
— Civil Aviation Authority of Nepal (CAAN)
— Civil Aviation Authority of Singapore (CAAS)
— Civil Aviation Authority of Swaziland
— Civil Aviation Regulatory Commission (CARC)
— COCESNA
— Croatia Control Ltd
— DCA Myanmar
— Department of Airspace Control (DECEA)
— Department of Civil Aviation, Republic of Cyprus
— DFS Deutsche Flugsicherung GmbH (DFS)
— Dirección General de Control de Tránsito Aéreo (DGCTA)
— DSNA France
— Dubai Air Navigation Services (DANS)
— Dutch Caribbean Air Navigation Service Provider (DC-ANSP)
— ENANA-EP ANGOLA
— ENAV S.p.A: Società Nazionale per l'Assistenza al Volo
— ENAIRe
— Estonian Air Navigation Services (EANS)
— Federal Aviation Administration (FAA)
— Finavia Corporation
— General Authority of Civil Aviation (GACA)
— Ghana Civil Aviation Authority (GCAA)
— Hellenic Civil Aviation Authority (HCAA)
— HungaroControl Pte. Ltd. Co.
— Instituto Dominicano de Aviacion Civil (IDAC)
— Israel Airports Authority (IAA)
— Iran Airports Co
— Irish Aviation Authority (IAA)
— ISAVIA Ltd
— Japan Air Navigation Service (JANS)
— Kazaeronavigatsia
— Kenya Civil Aviation Authority (KCAA)
— Latvijas Gaisa Satiksme (LGS)
— Letové prevádzkové Služby Slovenskej Republiky, Štátny Podnik
— Luchtverkeersleiding Nederland (LVNL)
— Luxembourg ANA
— Maldives Airports Company Limited (MACL)
— Malta Air Traffic Services (MATS)
— National Airports Corporation Ltd.
— National Air Navigation Services Company (NANSC)
— NATS UK
— NAV CANADA
— NAV Portugal
— Naviair
— Nigerian Airspace Management Agency (NAMA)
— Office de l'Aviation Civile et des Aeroports (OACA)
— Office National de LÁviation Civile (OFNAC)
— ORO NAVIGACIJA, Lithuania
— PNG Air Services Limited (PNGASL)
— Polish Air Navigation Services Agency (PANSA)
— PIA "Adem Jashari" - Air Control J.S.C.
— ROMATSA
— Sakaeronavigatsia Ltd
— S.E. MoldATSA
— SENEAM
— Serbia and Montenegro Air Traffic Services Agency (SMATSA)
— Serco
— skyguide
— Slovenia Control
— State Airports Authority & ANSP (DHMI)
— Sudan Air Navigation Services Department
— Tanzania Civil Aviation Authority
— Trinidad and Tobago CAA
— The LFV Group
— Ukrainian Air Traffic Service Enterprise (UkSATSE)
— U.S. DoD Policy Board on Federal Aviation
— Viet Nam Air Traffic Management Corporation (VATM)

Gold Associate Members - 12

— Airbus ProSky
— Anhui Sun Create Electronics Co., Ltd.
— Boeing
— Exelis, inc.
— FREQUENTIS AG
— GroupEAD Europe S.L.
— Inmarsat Plc
— Lockheed Martin
— Metron Aviation
— Raytheon
— Selex ES
— Thales

Silver Associate Members - 74

— 42 Solutions B.V.
— Adacel Inc.
— Aeronav Inc.
— Aireon
— Air Traffic Control Association (ATCA)
— 'Association Group of Industrial Companies "TIRA" Corporation
— ATAC
— ATCA – Japan
— ATECH Negócios em Tecnologia S/A
— Aveillant
— Aviation Advocacy Sarl
— Aviation Data Communication Corp (ADCC)
— Avibit Data Processing GmbH
— Avitech GmbH
— AZIMUT JSC
— Bayanat Engineering Group
— Brüel & Kjaer EMS
— Comsoft GmbH
— CGH Technologies, Inc
— CSSI, Inc.
— EADS Cassidian
— EIZO Technologies GmbH
— European Satellite Services Provider (ESSP SAS)
— Emirates
— ENAC
— Entry Point North
— Era Corporation
— Esterline
— Etihad Airways
— Exelis Orthogon
— Guntermann & Drunck GmbH
— Harris Corporation
— Helios
— Honeywell International Inc. / Aerospace
— IDS – Ingegneria Dei Sistemi S.p.A.
— Indra Navia AS
— Indra Sistemas
— INECO
— Integra A/S
— Intelcan Technosystems Inc.
— International Aero Navigation Systems Concern, JSC
— Jeppesen
— JMA Solutions
— Jotron AS
— LAIC Aktiengesellschaft
— LEMZ R&P Corporation
— LFV Aviation Consulting AB
— MDA Systems Ltd.
— Micro Nav Ltd
— The MITRE Corporation – CAASD
— MLS International College
— MovingDot
— NEC Corporation
— NLR
— Northrop Grumman
— NTT Data Corporation
— Núcleo de Comunicaciones y Control, S.L.U.
— PASSUR Aerospace
— Quintiq
— Rockwell Collins, Inc.
— Rohde & Schwarz GmbH & Co. KG
— RTCA, Inc.
— Saab AB
— Saab Sensis Corporation
— Saudi Arabian Airlines
— Schmid Telecom AG
— SENASA
— SITA
— Snowflake Software Ltd
— STR-SpeechTech Ltd.
— Tetra Tech AMT
— Think Research Limited
— Washington Consulting Group
— WIDE

Membership list correct as of 4 June 2015. For the most up-to-date list and organisation profiles go to www.canso.org/canso-members